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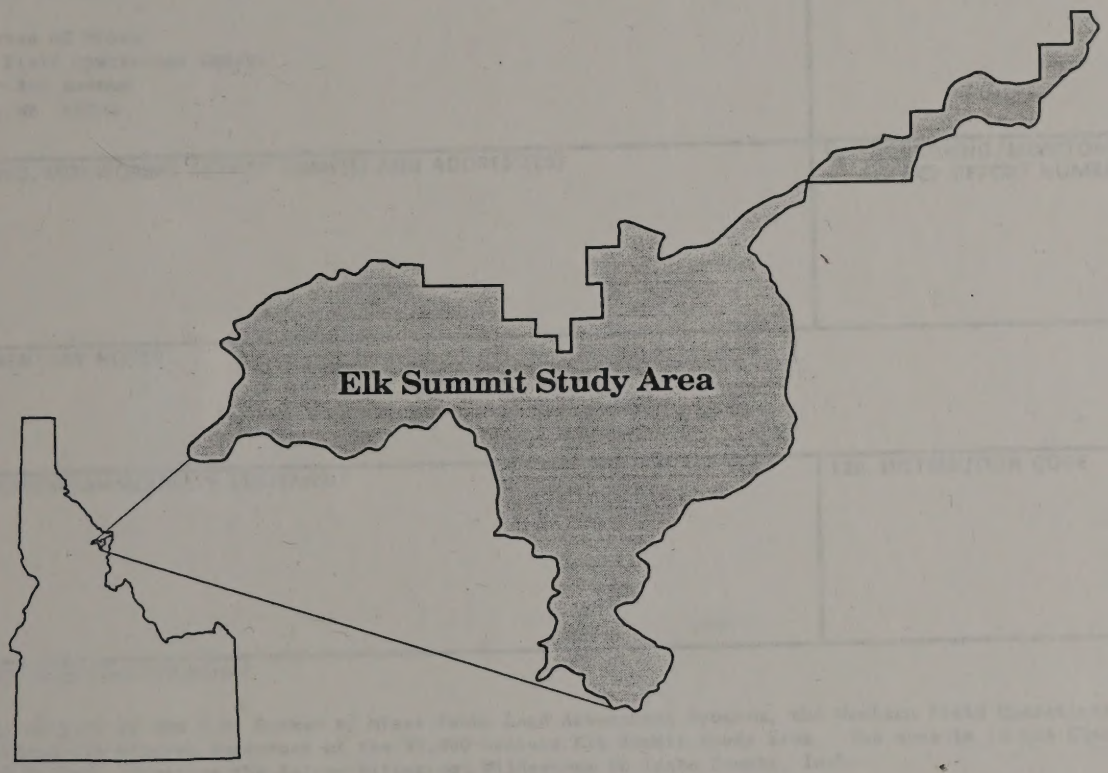

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In 1992, as part of the U.S. Bureau of Mines Idaho Land Assessment Program, the Western Field Operations Center investigated the mineral resources of the 30,300-hectare Elk Summit study area. The area is in the Clearwater National Forest, adjoining the Selway-Bitterroot Wilderness in Idaho County, Idaho.

The study area is underlain by granitic and metasedimentary rocks. Associated with these rocks are road metal (stone) resources, black sand mineral placer resources, and thermal water resources. Also present are abundant sand and gravel. Two of the five sites examined during the Bureau study have road metal (stone) resources, one has black sand mineral resources, one has thermal water resources. The fifth site is a black sand mineral placer occurrence. There is no evidence of petroleum or coal resources.

Idaho County records indicate that 38 mining claims, mostly black-sand placer, have been located in the study area. Twenty-three of the claims are current. Workings consist of a few pits and trenches at the placer, and two borrow pits.

The only mineral commodity produced from the area was about 1,500 tonnes of stone excavated from the Savage Pass and Swamp Creek borrow pits along the Elk Summit road, north of Hoodoo Lake. The stone was used to surface the road; these stone resources will continue to be used as needed.

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MINERAL RESOURCES OF THE ELK SUMMIT STUDY AREA IDAHO COUNTY, IDAHO

By
Terry J. Close

MLA 11-93

Western Field Operations Center
Spokane, Washington

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PREFACE

The Wilderness Act (Public Law 88-577, September 7, 1964) and related acts require the U.S. Bureau of Mines and U.S. Geological Survey to investigate certain Federal lands ". . . to determine the mineral values, if any, that may be present . . ." Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a U.S. Bureau of Mines mineral investigation of the Elk Summit study area, Idaho County, east-central Idaho. The study area is made up of three U.S. Forest Service RARE II areas; the entire North Fork Spruce-White Sand (1309) and Sneakfoot Meadows (1314) areas, and the eastern part of the Lochsa Face RARE II area (1311). The three RARE II areas were classified "Non-Wilderness Recommended" by the Forest Service (January 1979) during the Second Roadless Area Review and Evaluation (RARE II). Subsequent legislative proposals have recommended all or parts of the Elk Summit study area for classification as Wilderness. Mineral-related activities in the study area would be restricted by wilderness classification.

This open-file report contains data gathered and interpreted by personnel of the U.S. Bureau of Mines Western Field Operations Center, East 360 Third Avenue, Spokane, WA 99202. The report has been edited and approved by members of the Branch of Mineral Land Assessment, Washington, D.C.

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ABBREVIATIONS AND CONVERSIONS USED IN THIS REPORT
(metric units of measure unless noted)

cm	centimeter (cm x 0.3937 = inch)
m^3	cubic meter (M^3 x 1.3079 = cubic yard)
g	gram (g x 0.0022 = pound)
g/t (tonne)	gram per metric ton (g/t x 0.029 = troy ounce per short ton)
ha	hectare (ha x 2.471 = acre)
kg	kilogram (kg x 2.205 = pound)
kg/m^3	kilogram per cubic meter (kg/m^3 x 0.593 = pounds per cubic yard)
km	kilometer (km x 0.6214 = mile)
m	meter (m x 3.28 = feet)
ppb	part per billion
ppm	part per million (0.0001 percent)
km^2	square kilometer (km^2 x 0.291 = square mile)

NAMES, CHEMICAL FORMULAS, AND USES OF THE PRINCIPAL MINERALS IDENTIFIED IN THE ELK SUMMIT STUDY AREA

Black sand -- a heavy mineral concentrate, contained in placer gravel, that is retained by gravity on a vibrating table. In the Elk Summit study area, the black sand is comprised mainly of the noneconomic minerals quartz, magnetite, biotite, hornblende, and tourmaline with lesser amounts of the economic minerals ilmenite, garnet, and zircon. Sample analyses indicate that small amounts of columbite and monazite are also present.

Columbite $(Fe,Mn)(Nb,Ta)_2O_6$ -- a very minor constituent of the placer black sand in the Elk Summit study area, columbite is an ore of the metal niobium (columbium) as well as a source of tantalite. It is a natural oxide of niobium, tantalum, ferrous iron, and manganese.

Garnet, a group of minerals of formula: $A_3B_2(SiO_4)_3$ where A = Ca, Mg, Fe^{+2}, and Mn^{+2}, and B = Al, Fe^{+3}, V^{+3}, and Cr -- a constituent of the placer black sand in the study area, garnet is used as a semiprecious stone and as an abrasive (Bates and Jackson, 1980, p. 252).

Ilmenite ($FeTiO_3$) -- contained in the placer black sand, ilmenite is an ore of the metal titanium and of the commodity titanium dioxide. The metal titanium is used extensively in the aerospace and defense industries. The principal use of titanium dioxide is as a pigment in paints.

Monazite $(Ce,La,Y,Th,Nb)PO_4$ -- a very minor constituent of the placer black sand, monazite is an ore of rare-earths and thorium. It is a rare-earth mineral whose principal components are cerium, lanthanum, and neodymium oxides but which also contains thorium and uranium, along with other elements (Kiilsgaard and Hall, 1986, p. 5). Rare earths are used in catalysts, metal-alloys, glass, ceramics, magnets, phosphors, and electronic parts. Thorium's principal use is in ceramics and in mantles for incandescent lamps.

Road metal (stone) -- Elk Summit study area's principal mineral resource; rock suitable for surfacing macadamized roads (Bates and Jackson, 1980, p. 541.)

Zircon $Zr(SiO_4)$ -- a minor constituent of placer black sand, zircon is the chief ore of zirconium, and is used as a refractory; when cut

and polished, the colorless varieties provide exceptionally brilliant gemstones (Bates and Jackson, 1980, p. 771).

SUMMARY

In 1992, as part of the U.S. Bureau of Mines Idaho Land Assessment Program, personnel from the Western Field Operations Center investigated the mineral resources of the 30,300-ha Elk Summit study area. The study area is in the Clearwater National Forest, along the northern side of the Selway-Bitterroot Wilderness, between Elk Summit and the Lochsa River, in Idaho County, east-central Idaho. The area is made up of three U.S. Forest Service Second Roadless Area Review and Evaluation (RARE II) areas; the North Fork Spruce-White Sand, Sneakfoot Meadows areas, and the eastern part of the Lochsa Face area, RARE II nos. 1309, 1314, and 1311, respectively.

The slightly mineralized Elk Summit study area is underlain by granitic- and metasedimentary-rocks. Associated with these rocks are road metal (stone), black sand mineral placer, and thermal water resources. Also present are abundant common sand and gravel.

Two of the five sites examined during the Bureau study have road metal (stone) resources, one has black sand mineral resources, one has thermal water resources. The fifth site is a black sand mineral placer occurrence. There is no evidence of petroleum or coal resources.

There are no mining districts; however, Idaho County records indicate that 38 mining claims, mostly placer, have been located in the study area. Twenty-three of the claims, covering the Hoodoo black sand mineral placer, are current. Workings consist of a few pits and trenches, at the placer, and two borrow pits.

The only mineral commodity produced from the area was about 1,500 t of stone excavated from the Savage Pass and Swamp Creek borrow pits along the Elk Summit road, north of Hoodoo Lake. The stone was used (as road metal) to surface the road; these stone resources will continue to be used as needed.

The black sand mineral placer resource is along Hoodoo Creek in the southern part of the study area. At the Hoodoo placer there are about 3.8 million m^3 (5 million cubic yards) of gravel containing $0.95 worth of ilmenite per cubic meter ($0.73 per cubic yard) of gravel. The estimated cost to mine the ilmenite would be about $8.32/$m^3$ ($6.36 per cubic yard) of gravel processed; several times its value. The placer is therefore classified a resource. At nearby Kooskooskia Meadow is a black sand mineral placer occurrence that is large but much lower grade than the Hoodoo placer.

A thermal water resource is at Jerry Johnson hot springs, along the western side of the study area. This large resource is used for bathing. The water is hot enough to be used locally for space heating and aquaculture. However, there are no nearby buildings to heat nor aquaculture facilities to be supplied with hot water.

The study area also contains large quantities of low-value sand and gravel. However, no unique, high-value products can be economically produced from these occurrences.

INTRODUCTION

This report describes the USBM (U.S. Bureau of Mines Western Field Operations Center) evaluation of the mineral resources and potential of the Elk Summit study area. The USBM has been conducting mineral surveys of roadless lands in Idaho that have been proposed in the past as wilderness. USBM personnel examine individual mineralized sites to evaluate their mineral and energy resources. The results of these examinations are used in the determinations of the suitability of the areas studied for inclusion into the National Wilderness Preservation System. Although the immediate goal of this and other USBM mineral surveys is to provide data for the President, Congress, government agencies, and the public for land-use decisions, the long-term objective is to ensure the Nation an adequate and dependable supply of minerals at a reasonable cost. All USBM data are on file at the Western Field Operations Center, Spokane, Washington.

The Elk Summit study area is made up of three U.S. Forest Service RARE II (Second Roadless Area Review and Evaluation) areas: 1) the North Fork Spruce-White Sand area (1309), 2) the Sneakfoot Meadows area (1314), and 3) the eastern-part of the Lochsa Face area (1311). The three RARE II areas were not included in the Forest Service Wilderness recommendations (January 1979). However,the Elk Summit study area was later proposed for Wilderness designation by various Congressional bills and so was studied during 1992 by the USBM.

Mineral-related activities in the study area would be restricted by Wilderness designation.

Geographic Setting

The 30,300-ha Elk Summit study area is about 144 km east of the town of Orofino, Idaho (fig. 1). The area is in the Powell Ranger District of the Clearwater National Forest, Idaho County, Idaho. Near the northern side is the Kelly-Cayuse study area, studied by the USBM in 1989 and 1990 (Miller, 1992). The pyramid-shaped Elk Summit study area is bounded on the northern side by the Lochsa River and on the southern side by the Selway-Bitterroot Wilderness (fig. 2). A U.S. Forest Service gravel road (FS360), bisecting the central part, provides access to the Elk Summit entrance to the Selway-Bitterroot Wilderness. It transverses the study area beginning at Idaho State Highway 12 near Powell Ranger Station, passing south to Hoodoo Lake. Many maintained forest trails cross the study area.

Elevations range between 908 m along the Lochsa River near Warm Springs Creek to 2,306 m at the summit of Tom Beal Peak, about 8 km to the south.

Water is plentiful in this rugged, high-mountain area: permanent streams flow through most of the canyons. Precipitation falls year-round; much falls as snow between the months of November and May, and usually is deep in the mountains.

Winters are cold; extended periods of freezing temperatures can be expected.

Most of the study area is covered by thick soil which supports dense vegetation, consisting mainly of ponderosa-pine, yellow-pine, lodgepole-pine, buck brush, and grass. The soil- and vegetative-cover make the study of the rocks and associated mineralized structures difficult because of the scarcity of exposures.

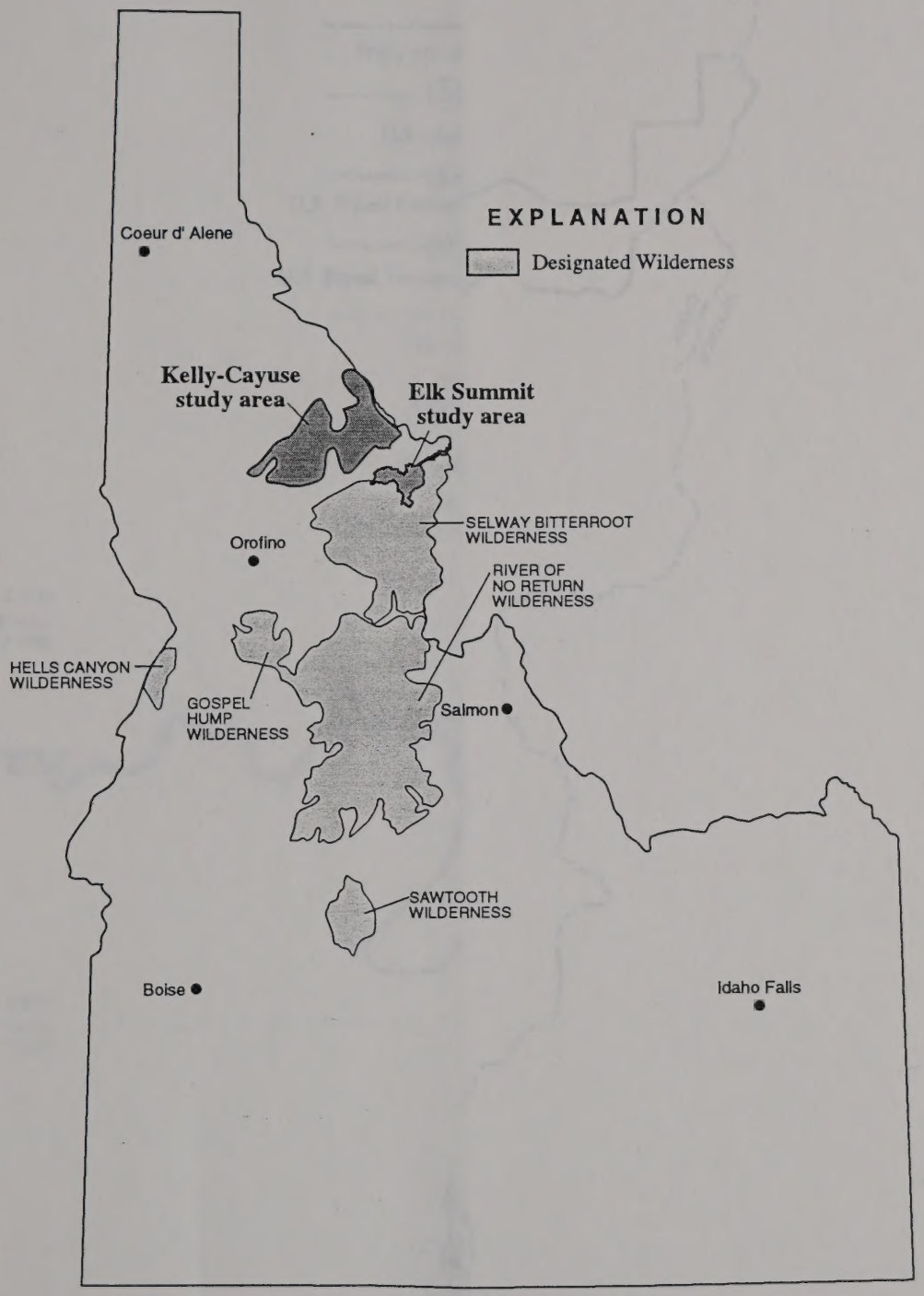

Figure 1. - Location of the Elk Summit study area.

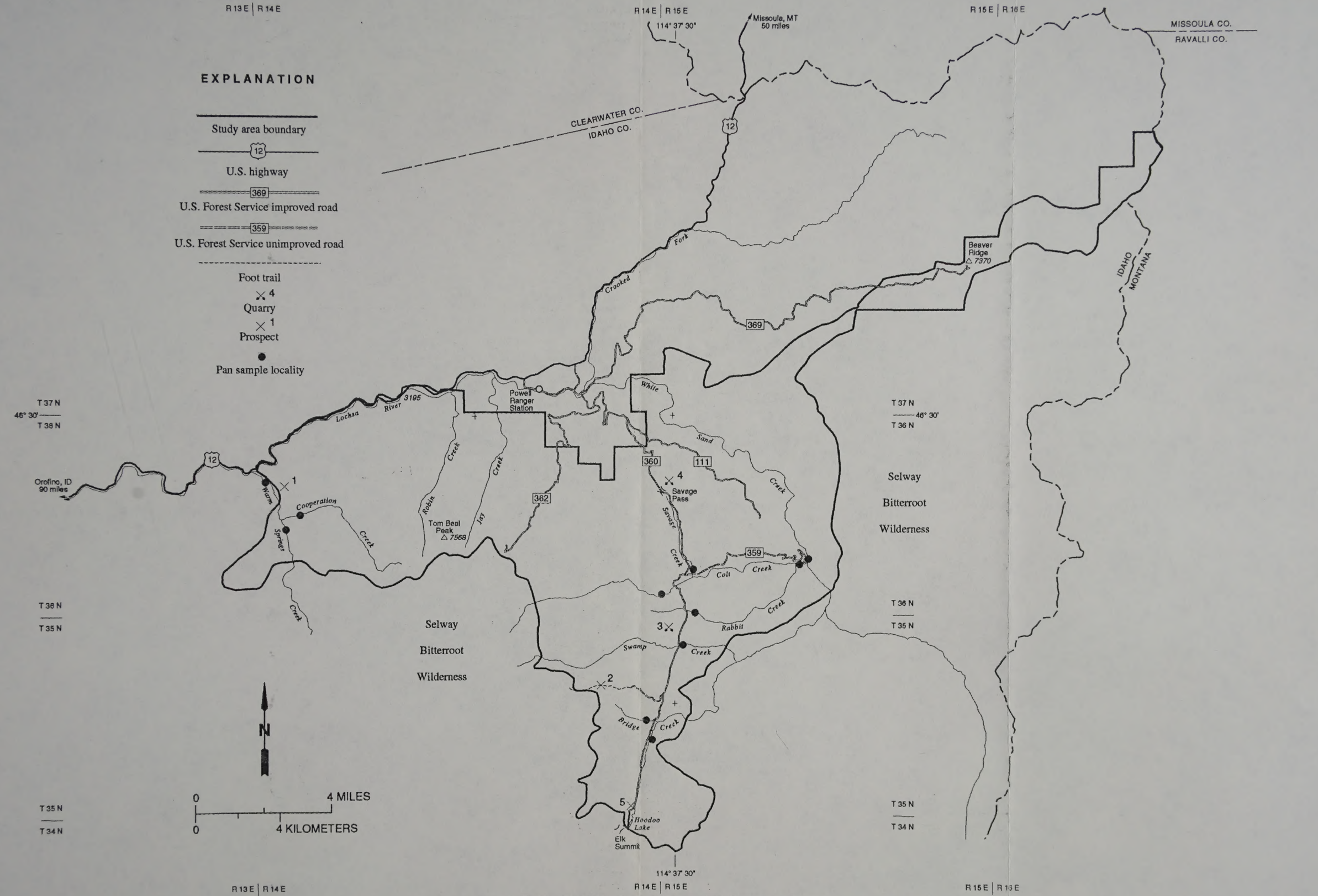

Figure 2. - Mineralized sites in the Elk Summit study area.

TABLE 1.--Index of mineralized sites in the Elk Summit study area.

[Mineralized sites shown on Figure 2; principal commodities are shown in parentheses.]

Name	(fig. 2, no.)
Jerry Johnson hot springs (thermal water)	1
Kooskooskia Meadow placer (ilmenite)	2
Swamp Creek pit (road metal)	3
Savage Pass pit (road metal)	4
Hoodoo placer (ilmenite)	5

Previous Studies

Very little has been written about the mineral resources and geology of the Elk Summit study area. Published reports containing data pertinent to the area are sketchy; they consist of broad regional studies.

Storch and Holt (1963) investigated the Hoodoo placer. Waring (1965) summarized the thermal springs of the United States including Jerry Johnson hot springs in the study area. Ross (1971) summarized the geothermal potential of Idaho. Rember and Bennett (1979) prepared a geologic map of the Hamilton 2° quadrangle, covering the northern part of the study area. Toth and others (1983) investigated the geology and mineral resource potential of the adjacent Selway-Bitterroot Wilderness. Zilka and Hamilton (1982a and 1982b) investigated the mineral resources of the Wilderness, and Zilka and others (1987) conducted a mineral study of the lands administered by the Clearwater National Forest. Lewis and others (1992) mapped the geology of the Lochsa River area as part of the Idaho Land Assessment Program.

Present Study

The USBM conducted prefield and field phases of the Elk Summit study in 1992. The prefield studies consisted of the acquisition of all pertinent minerals data from Idaho County records, and Federal records and publications. The Idaho Geologic Survey provided data on the geology and mineral resources of the study area

Field studies, hampered by the paucity of rock exposures, consisted of examinations of all of the mineralized sites that could be identified. A total of five were examined; at these sites are only a few pits and trenches (fig. 2). The largest workings consist of borrow pits near Savage Pass (fig. 2, no. 4) and Swamp Creek (no. 3). These pits yielded stone (road metal) applied to the surface of the Elk Summit forest road (FS360).

In 1955 the USBM and in 1965 the U.S. Forest Service collected 16 samples (nos. B1-B10 and G1-G6, respectively) from the Hoodoo placer. During 1992 investigations the USBM collected another 17 samples--from Hoodoo placer (nos. 3-6), Kooskooskia placer (nos. 17 and 18), and creeks near these placers (pan samples). Five rock (lode) samples (nos. 1, 2, and 51-53) were also taken from the study area. Pertinent data resulting from all of the sampling are contained in appendices B and C.

The types of placer samples taken by the USBM in 1992 consisted of: Pan-usually a 35 cm-diameter pan filled to the brim with placer gravel, and Auger-a measured bulk sample excavated with a 10- or 15-cm-diameter Ivan auger.

The USBM placer samples taken in 1992 were concentrated in the field by panning. At the completion of the sampling all placer test sites were refilled and leveled. The concentrate from each sample was analyzed by IGAL, Inc., laboratory of Cheney, Wash.

Because of the complexities involved with analyses of black sand samples, they were divided into three analytical suites. The three suites consisted of: 1) metals including Au (gold) Ag (silver), As (arsenic), Bi (bismuth), Cu (copper), Hg (mercury), Mn (manganese), Mo (molybdenum), Pb (lead), Sb (antimony), W (tungsten), and Zn (zinc); 2) black sand economic metals/elements; Nb (niobium - columbium), Ti (titanium), Y (yttrium), and Zr (zirconium); and, 3) rare earth elements Ce (cerium), and Y (yttrium).

The types of rock samples collected by the USBM during this study were: Chip-a measured series of rock chips taken in a continuous line across a mineralized zone or other exposure, and Select-rock pieces taken to determine the maximum metal concentrations present. These samples were analyzed only for the first of the three suites of elements listed above.

ACKNOWLEDGEMENTS

Officials at the U.S. Forest Service Clearwater Forest Headquarters and Powell Ranger District rendered valuable assistance, including road and mining claim information. Also, Pamela Bowen, Clearwater Forest geologist, aided in the examination of the Hoodoo placer. USBM workers Ron Mayerle and Ron Stotelmeyer rendered valuable assistance during the field studies.

GEOLOGIC SETTING

The Elk Summit study area is in the eastern part of a tectonic province whose main elements include Cretaceous-age Idaho batholith intrusive rocks and a complex sequence of Precambrian-age metasedimentary rocks (Zilka and Hamilton, 1982a, p. 10-12). The western two-thirds of the study area is underlain mainly by granodiorite of the batholith. The batholith units are shown to be Cretaceous-age (k) or younger on figure 3. The eastern one-third is underlain mainly by metasedimentary rocks, correlated with the Belt Supergroup. These units are shown as older than Cretaceous-age on figure 3. Migmatite is extensively developed along most major intrusive-metasedimentary-rock contact zones. Dikes of andesite, dacite, quartz latite, aplite, and pegmatite are randomly distributed in swarms throughout the area.

Intrusive and metamorphic rocks comprise the stone (road metal) resources in the study area. Intrusive rocks were the source of the black sand minerals, concentrated by weathering and action of water, in the Hoodoo and Kooskooskia Meadow placers. Thermal water at Jerry Johnson hot springs flows from fractures that penetrate hot intrusive rocks.

MINING HISTORY

There is little history of mining in the Elk Summit study area. Zilka and others (1987) listed 38 mining claims, mostly placers, within the study area. Also, BLM records list 23 current placer claims (held since 1943) in the study area at the Hoodoo placer (fig. 2, no. 5). A few historic claims were also located over Jerry Johnson hot springs (no. 1) and Kooskooskia Meadow placer (no. 2).

The only mineral commodity produced from the area is stone that was crushed for use in road construction. The stone (road metal) was extracted from two pits located along the Elk Summit road, which bisects the study area (fig. 2, nos. 3 and 4). The stone consists of intrusive and metamorphic rock that is hard enough to stand up to the abrasion of road use. Based on the sizes of the two pits, it can be estimated that about 1,500 t of stone has been removed.

COMMODITIES

Five mineralized sites (prospects and thermal water springs) were identified during the USBM investigation of the Elk Summit study area (fig. 2 and table 1). Two of the sites, Savage Pass and Swamp Creek pits (fig. 2, nos. 4 and 3, respectively), have road metal (stone)

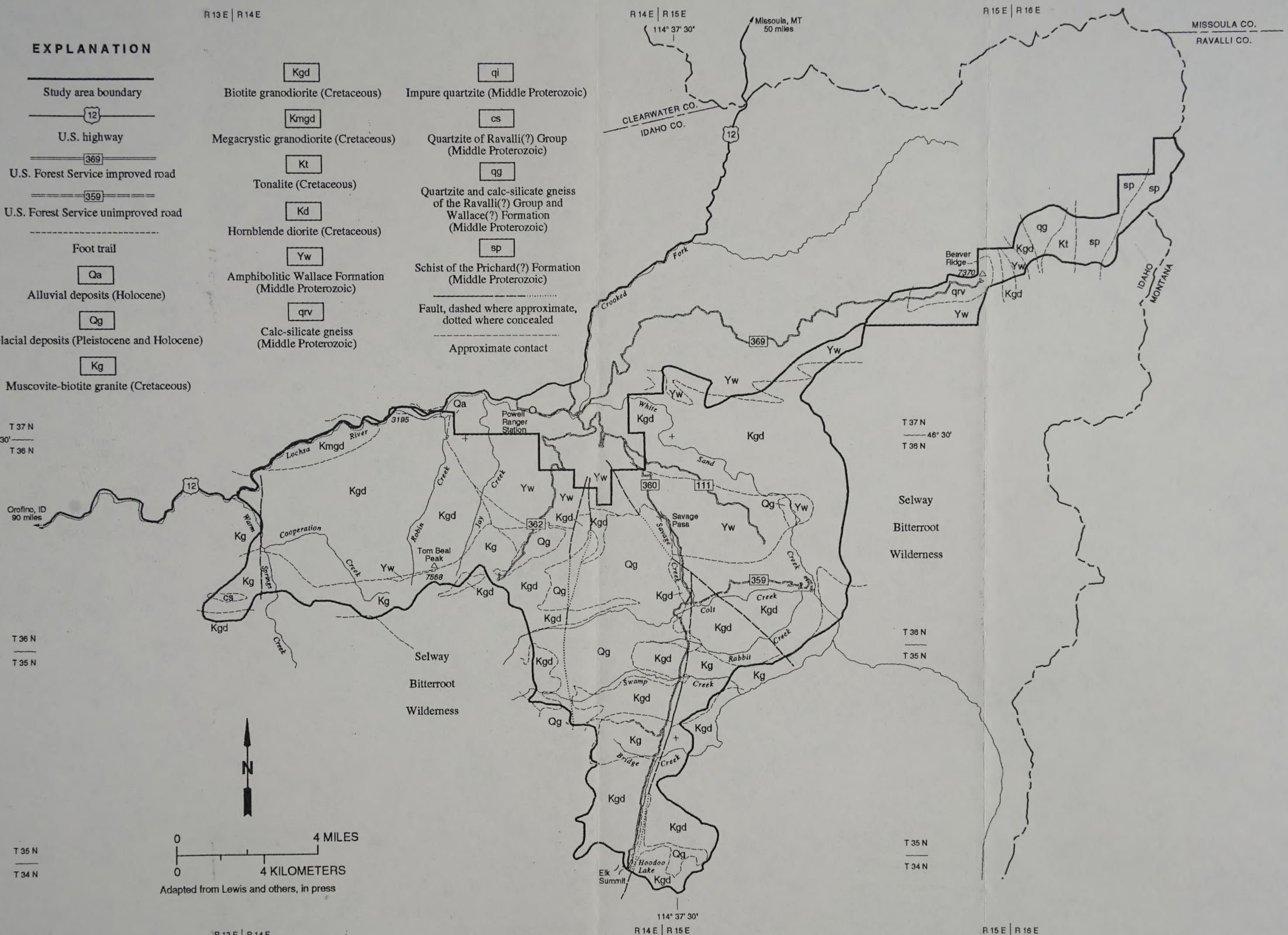

Figure 3. - Generalized geologic map of the Elk Summit study area.

resources; one, Hoodoo placer (no. 5), has black sand mineral resources; another, Jerry Johnson hot springs (no. 1), has thermal water resources; and the fifth site, Kooskooskia Meadow (no. 2), is a low grade, black-sand-mineral placer occurrence. Abundant sand and gravel are also present in the study area. There is no evidence of petroleum or coal resources.

Pertinent data for all samples are listed in appendices A through C. Descriptions of the commodities and sites in the study area follow.

Road Metal (Stone)

Stone suitable for use as road metal (road gravel) is quite common in the study area. However, only the Savage Pass and Swamp Creek pits have been developed to supply stone. Material was excavated from these two sites to surface the Elk Summit road.

The cost of hauling road metal is a major factor affecting its utilization. Sources of supply usually are developed as close to where the material is to be used as is possible. Hauling stone from sources located outside the study area would be far more expensive. Therefore the two pits in the study area will probably continue to be utilized, as needed, to supply material for maintenance of the Elk Summit road.

NAME: Savage Pass pit

MAP NO.: Figure 2, no. 4

LOCATION: NW. 1/4, NE. 1/4 sec. 18, T. 36 N., R. 15 E.; lat 46°30'30"N., long 114°27'50"W.; at Savage Pass.

ELEVATION: 1,880 m

ACCESS: Southeast about 13.9 km from Powell via the maintained Elk Summit graveled road (FS360).

GEOLOGY: The pit exposes metasedimentary rock intruded by granitic rock. The metasedimentary rock is argillaceous, calcareous, quartzitic, schistose to gneissic, and contains chlorite, iron stain, and quartz veinlets as thick as 5 cm. The granitic rock contains narrow pegmatite dikes.

WORKING: A 61 by 61 m pit estimated to have yielded about 1,000 t of the stone used to surface the Elk Summit road.

SAMPLE RESULTS: A grab sample (no. 1) of the metasedimentary rock and a grab sample (no. 2) of the granitic rock each had no significant metal concentrations (appendix C).

CONCLUSIONS: A stone (road metal) resource, that will continue to used as needed, is of sufficient size to meet any anticipated requirements for maintaining the Elk Summit road.

NAME: Swamp Creek pit

MAP NO.: Figure 2, no. 3

LOCATION: SW. 1/4 sec. 5 T. 35 N., R. 15 E.; lat 46°24'10"N., long 114°37'12"W.; along the Elk Summit road on the north side of the bridge crossing Swamp Creek.

ELEVATION: 1,658 m

ACCESS: South about 20.8 km from Powell by the Elk Summit road.

GEOLOGY: Granitic rock containing pegmatite dikes.

WORKINGS: The borrow pit measures about 61 by 76 m; about 500 t of material have been removed.

SAMPLE RESULTS: None taken.

CONCLUSIONS: A resource of road metal, the pit will continue to yield material for use in road construction as needed.

Black Sand Minerals

The black sand mineral resources in the Elk Summit study area are contained in the Hoodoo placer near Elk Summit (fig. 2, no. 6). Lower-grade black sand mineral placer occurrences are at Kooskooskia Meadow (fig. 2, no. 2) and along nearby steams (appendices B and C). The Hoodoo placer and Kooskooskia Meadow are described later. The locations of the pan samples from the nearby streams--from Swamp, Colt, Cooperation, Savage, White Sand, and Warm Springs Creeks--are listed in appendices A and B; their locations are shown on figure 2.

The principal economic mineral contained in the black sand mineral placers is ilmenite. Also present are small amounts of the minerals columbite (niobium), garnet, zircon, and monazite (rare earths and thorium). These minerals could be recovered during ilmenite mining but their total value would be insignificant.

Ilmenite ($FeTiO_3$), an ore of the metal titanium and of the commodity titanium dioxide, is sold on the basis of it's TiO_2 (rutile) content. The ilmenite in the placers in the Elk Summit study area averages about 46 percent TiO_2. A TiO_2 price of $66.00 per metric ton ($0.066/kg)--bulk, 54 percent TiO_2 f.o.b. Australian ports (USBM, 1993, p. 82)--was used in the calculations in this report.

NAME: Hoodoo placer

MAP NO.: Figure 2, no. 5

OWNER: R. A. Lamphere.

LOCATION: Secs. 25 and 36, T. 35 N., R. 14 E.; lat 46°19'21"N., long 114°38'59"W.; along Hoodoo Creek in the vicinity of Hoodoo Lake.

ELEVATION: 1,700 to 1,830 m

ACCESS: South about 32 km from Powell by the Elk Summit road.

HISTORY: In the past, the Hoodoo placer has been called the Elk Summit claim groups and Candy placer. Zilka (1982a, p. 20) reported that the first four claim groups were located in 1943; the Hoodoo and Candy claim groups--at and downstream from Hoodoo Lake; the Flora group--east of the lake and extending west to Horse Heaven Meadow; and the Judy group--in Horse Heaven Meadow. In 1966 the Candy placer was examined by the U.S. Forest Service. The current claim groups covering the placer--Hoodoo and Horse Heaven claims--were relocated between 1989 and 1991. Although

claimed almost continuously since 1943, no production has been recorded from the placer.

GEOLOGY: Black sand-bearing gravel is in narrow stream channels and broad meadows.

The principal deposits are the 3,962-m-long, 122-m-wide, and 4.6-m-thick placer along Hoodoo Creek north of Hoodoo Lake, and the 1,829-m-long, 152-m-wide, and 4.6-m-thick placer underlying Horse Heaven Meadow (fig. 4). These placers consist of glacial till reworked by the winnowing action of water. The resulting gravel is moderately-sorted and -stratified, and contains large quantities of black sand. Glacial erratics as much as 1.8 m in diameter are scattered over the placers.

The black sand samples collected by the USBM were comprised mainly of the common minerals quartz, magnetite, ferromagnesian minerals, and tourmaline with lesser amounts of the possibly economically important minerals ilmenite, garnet, and zircon. Sample analyses indicate that small amounts of columbite and monazite are also present. The black sand minerals were weathered from the surrounding dioritic country rock.

WORKINGS: A few small test pits.

SAMPLE RESULTS: The U.S. Forest Service took six samples (nos. G1-G6) in 1964. USBM personnel excavated ten samples in 1955 (nos. B1-B10) and augured another four (nos. 3-6) in 1992. The locations of all samples are shown on figure 4; descriptions and analyses are listed in appendices A and B.

The six unpanned bulk samples taken by the Forest Service had between 14.2 and 34.4 kg/m^3 ilmenite, averaging 25.3 kg/m^3; appendix A. The columbite content of these samples was not determined.

The ten channel samples taken by the USBM in 1955 were excavated by hand from pits 0.6 to 2.7 m deep, totaling 9.1 m. They ranged between 3.6 to 87.9 kg/m^3 ilmenite, trace monazite, trace to 0.59 kg/m^3 garnet, and trace to 1.2 kg/m^3 zircon. They averaged about 31 kg/m^3 ilmenite, trace monazite, 0.42 kg/m^3 garnet, and 0.59 kg/m^3 zircon. The ilmenite fraction assayed 46 percent TiO_2, 35.6 percent Fe, and 0.22 percent Cb_2O_5 (Storch and Holt, 1963, p. 60 and 62). The four samples taken with auger by the USBM in 1992 confirmed the previous sampling.

RESOURCES: The resources at the Hoodoo placer total approximately 3.8 million m^3 (5 million cubic yards) of gravel averaging 31 kg/m^3 (52 pounds per cubic yard) ilmenite--(a total of 117,800 t [130,000 short tons]); about 14.3 kg/m^3 (24 pounds per cubic yard) is TiO_2--(54,188 t [59,700 short tons]). The resource also contains about 0.07 kg/m^3 (0.12 pounds per cubic yard) Cb_2O_5--(257 t [283 short tons]) (Storch and Holt, 1963, p. 62, and Zilka and Hamilton, 1982b, p. 10).

CONCLUSIONS: The amount of ilmenite identified has a value of about $3.6 million based on a price of $0.066/kg for TiO_2 (titanium dioxide) (USBM, 1993, p. 82). The value of the other commodities that could be recovered would be insignificant.

The Hoodoo placer area lacks mining infrastructure--it is far from a paved highway, power line, or living accommodations.

Stebbins (1987, pp. 112-130) developed a mining model for a placer similar to the Hoodoo. This system would entail mining 150 days per year at a rate of about 765 m^3 per day; overburden would be removed at

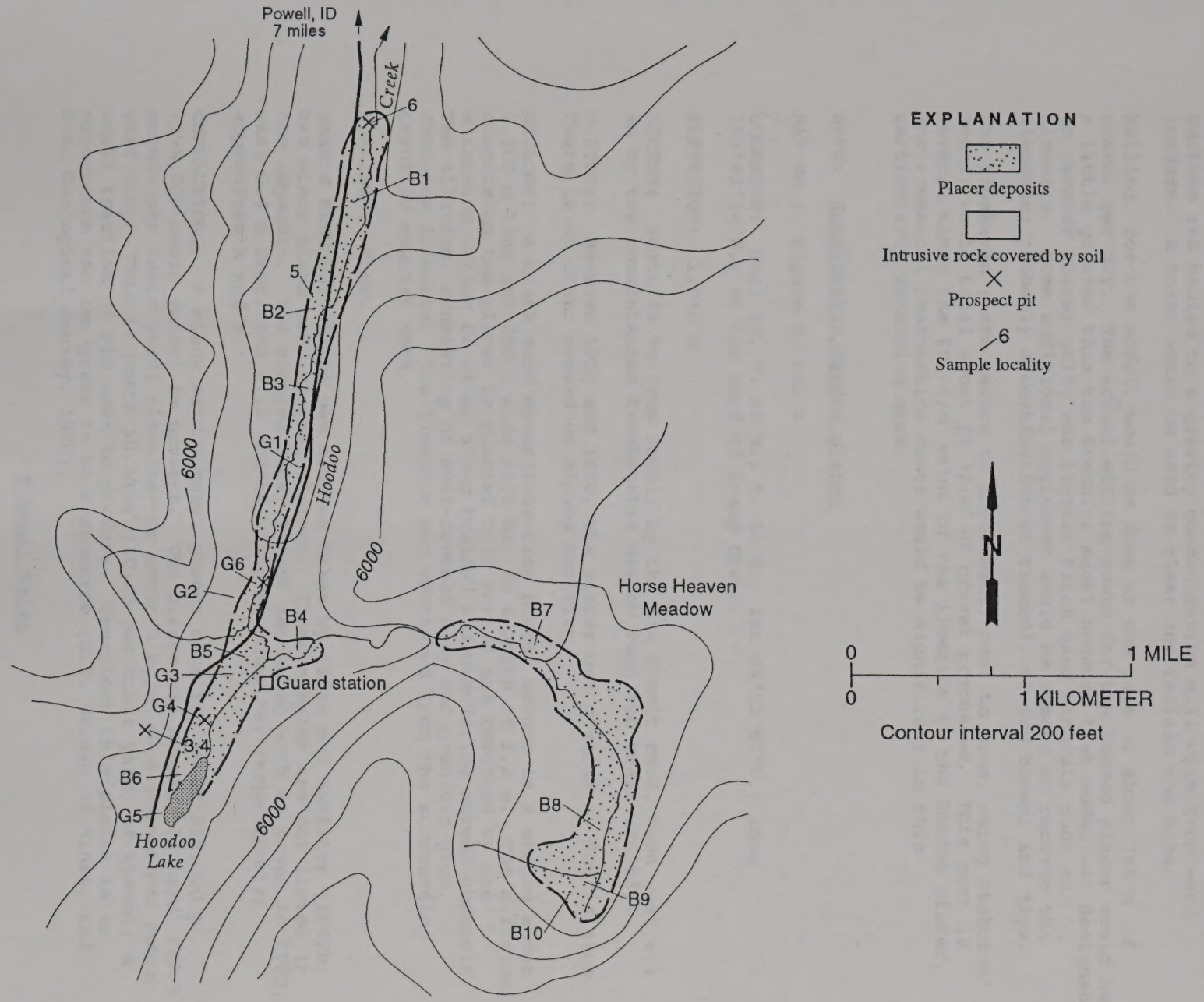

Figure 4. - Hoodoo placer.

the rate of 1,910 m^3 per day. The overburden at the Hoodoo is thinner and would be removed with a scraper. The gravel would be mined with a backhoe and hauled to a gravity concentration mill with front-end loaders. A dozer would be used to clear and reclaim the mine.

Milling, for the model, would be done at the rate of about 765 m^3 of gravel per day. The actual milling costs for the Hoodoo placer would be a little greater than the Stebbins model because that model was designed to recover placer gold, not lighter black sand minerals such as ilmenite. Some additional equipment would be needed to recover the ilmenite; probably a combination of trommel, sluice boxes, and jigs.

The breakeven (zero return on investment) cost to mine, using Stebbins' model, would total about \$8.32/m^3 of gravel processed. This cost is several times the \$0.95/m^3 value of the ilmenite in the Hoodoo placer. Environmental restoration costs would be significant in this particularly sensitive area.

NAME: Kooskooskia Meadow placer

MAP NO.: Figure 2, no. 2

LOCATION: Sec. 10, T. 35 N., R. 14 E.; lat 46°22'52"N., long 114°41'14"W.; at the head of Swamp Creek.

ELEVATION: 1,860 m

ACCESS: South 24 km from Powell by the Elk Summit road, then west 6.1 km by the unmaintained Kooskooskia Meadow road and trail (FS358).

HISTORY: Between 1930 and 1980, the placer was covered by four claims. There is no other record of mining activity.

GEOLOGY: A black sand mineral-bearing placer occurs in a meadow about 1,200 m long and 360 m wide (432 ha) to a depth of 1.2 m. The alluvium comprising the placer is glacial till sorted and reworked by the winnowing action of water along braided and meandering stream channels. The alluvium, consisting of soil-covered clay and granitic grus, contains ilmenite. The ilmenite was weathered from the surrounding granitic country rock.

WORKINGS: None.

SAMPLE RESULTS: Three pan samples taken by Zilka and Hamilton (1982b) had minor black sand mineral content. These samples are not listed in the appendix. Two samples (nos. 17 and 18) taken with an auger in 1992, each 0.4 m deep, had 5.16 and 16.97 kg/m^3 ilmenite, respectively; appendices A and B.

CONCLUSIONS: A black sand mineral placer totaling about 518,000 m^3 (396,000 cubic yards) is present. The placer may average 11 kg/m^3 (18.5 pounds per cubic yard) ilmenite--or about 5 kg/m^3 (8.4 pounds per cubic yard TiO_2. This is worth \$0.33/m^3 (\$0.43 per cubic yard) of gravel; a small fraction of the cost to produce. Therefore this placer is an occurrence too low grade to be a resource (U.S. Bureau of Mines, and U.S. Geological Survey, 1980).

Thermal Water

Thermal water is defined as "water, generally of a spring or geyser,

whose temperature is appreciably above the local mean annual air temperature" (Bates and Jackson, 1980, p. 648). Jerry Johnson hot springs (fig. 2, no. 1) is the only thermal water spring in the Elk Summit study area.

NAME: Jerry Johnson hot springs

MAP NO.: Figure 2, no. 1

LOCATION: Sec. 18 T. 36 N., R. 13 E.; lat 46°27'46"N., long 114°52'20"W.; on Warm Springs Creek about 1.6 km above it's confluence with the Lochsa River.

ELEVATION: 975 m

ACCESS: West about 11.2 km by State Highway 12 from Powell, then south 1.6 km by Forest Trail 863.

GEOLOGY: Thermal water flows from fractures transecting granitic rock. Waring (1965) and Ross (1971) reported a water flow of about 1,703 liters per minute at a temperature of 100° to 130° C from the three principal springs. These three springs and a number of smaller ones are in a area about 805 m long and 152 m wide. The granitic rocks around the spring area are hydrothermally altered, iron stained, leached, brecciated, and cemented by sandy calcite and minor sulfur. These rocks were sampled to determine if metals may have been deposited as a result of the hot springs activity.

FACILITIES: The springs are primitively developed; thermal water is diverted into hand-built stone-lined-pools for bathing.

SAMPLE RESULTS: Three chips samples (nos. 51-53) of the rocks altered by the hot water had no significant metal content (appendix C).

CONCLUSIONS: A thermal water resource, hot enough to be used locally for space heating and aquaculture, is present. However, there are no nearby buildings to heat nor aquaculture facilities to be supplied with hot water. Further assessment of the resource, including drilling, would be needed before any development. No metals resources are apparent.

Sand and Gravel

Large quantities of sand and gravel are along streams that cross the study area. However, no unique, high-value products could be produced from these deposits. The commodity can be produced more readily from existing sources located outside the study area closer to construction sites.

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APPENDICES

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APPENDIX A.--Descriptions and analyses of placer samples from the Elk Summit study area.

[Placer sites shown on figure 2; m, meter; m^3, cubic meter; $/$m^3$, dollar per cubic meter; a gold price of $11.25 per gram ($350 per troy ounce) was used in the calculations; the values for the auger samples were determined by assaying the placer concentrates, the values were extrapolated using a weight factor for the gravel of 1,957 kg/m^3; Ce, cerium; La, lanthanum; Nb, niobium (columbium); Ti, titanium; and Y, yttrium; kg/m^3, kilogram per cubic meter; NA, not applicable; NR, not reported; NS, no sample taken; --, not analyzed; *, sample from bedrock; Do.., same as above.]

(fig. 2 no.)	Name	Sample No.	Sample Type	Sample Depth interval (m)	Sample Volume (m^3)	Gold ($/$m^3$)	Ilmenite (kg/m^3)	Ce (kg/m^3)	La (kg/m^3)	Nb (kg/m^3)	Ti (kg/m^3)	Y (kg/m^3)	Remarks
6	Hoodoo placer	3	Auger	0- 1.2	0.088	$0.00	--	0.02	0.01	0.01	2.82	0.003	Soil, clay, and granitic grus.
		4		1.2- 1.3	0.002	$0.00	--	0.95	0.37	0.32	169.37	0.32	Coarse granitic grus.
		5	Do..	0- 0.6	0.045	$0.00	--	0.04	0.01	0.03	27.58	0.01	Fine granitic gravel.
		6*	Do..	0- 0.8	NS	-	-	-	-	-	-	-	Soil and gravel.
				0.8-1.2	0.028	$0.00	--	0.08	0.03	0.03	22.53	0.02	Medium-grained grus on granitic bedrock.
		G1	1/ Channel	0- 1.5	0.003	--	34.75	--	--	--	--	--	Soil, grus, and bedrock.
		G2	1/ Do..	0- 0.7	NS	-	-	-	-	-	-	-	Soil and gravel.
				0.7-1.0	0.004	--	28.95	--	--	--	--	--	Gravel and granitic bedrock.
		G3	1/ Do..	0- 0.8	0.004	--	16.44	--	--	--	--	--	Stream gravel.
		G4	1/ Do..	NR	0.004	--	28.58	--	--	--	--	--	Do..
		G5	1/ Do..	NR	0.003	--	14.57	--	--	--	--	--	Gravel.
		G6	1/ Do..	0- 0.9	0.003	--	28.02	--	--	--	--	--	Gravel and granitic bedrock.
		B1	2/ Do..	NR	NR	--	43.11	--	--	--	--	--	Gravel.
		B2	2/ Do..	NR	NR	--	13.42	--	--	--	--	--	Do..
		B3	2/ Do..	NR	NR	--	8.31	--	--	--	--	--	Do..
		B4	2/ Do..	NR	NR	--	20.37	--	--	--	--	--	Do..
		B5	2/ Do..	NR	NR	--	1.54	--	--	--	--	--	Do..
		B6	2/ Do..	NR	NR	--	4.04	--	--	--	--	--	Do..
		B7	2/ Do..	NR	NR	--	0.30	--	--	--	--	--	Do..

APPENDIX A.--Descriptions and analyses of placer samples from the Elk Summit study area--continued.

(fig. 2 no.)	Name	Sample No.	Type	Depth interval (m)	Volume (m^3)	Gold ($/$m^3$)	Ilmenite (kg/m^3)	Ce (kg/m^3)	La (kg/m^3)	Nb (kg/m^3)	Ti (kg/m^3)	Y (kg/m^3)	Remarks
6	Hoodoo placer	B8 2/	Channel	NR	NR	--	39.78	--	--	--	--	--	Gravel.
		B9 2/	Do..	NR	NR	--	82.94	--	--	--	--	--	Do..
		B10 2/	Do..	NR	NR	--	2.02	--	--	--	--	--	Do..
2	Kooskooskia Meadow placer	17	Auger	0- 1.2	0.040	$0.00	--	--	--	--	5.16	--	Soil, clay, and granitic grus.
		18	Do..	0- 1.2	0.040	$0.00	--	--	--	--	16.97	--	Do..
Pan samples from selected creeks in the study area, shown on figure 2.													
	Bridge Creek	NA	Pan	NA	0.002	$0.00	--	--	--	--	--	--	Granitic rock flour.
	Swamp Creek	NA	Do..	NA	0.002	$0.00	--	--	--	--	53.89	--	Stream gravel.
	Colt Creek	NA	Do..	NA	0.003	$0.00	--	--	--	--	6.12	--	Granitic gravel.
	Do..	NA	Do..	NA	0.003	$0.00	--	--	--	--	16.95	--	Do..
	Cooperation Creek	NA	Do..	NA	0.007	$0.00	--	--	--	--	4.37	--	Do..
	Hoodoo Creek	NA3/	Auger	0- 0.4	0.028	$0.00	--	--	--	--	37.23	--	Stream gravel on granitic bedrock.
	Rabbit Creek	NA	Pan	NA	0.003	$0.00	--	--	--	--	--	--	Granitic grus.
	Savage Creek	NA	Do.	NA	0.003	$0.00	--	--	--	--	8.94	--	Granitic gravel.
	Warm Springs Creek	NA	Do..	NA	0.003	$0.00	--	--	--	--	14.99	--	Do..
	Do..	NA	Do..	NA	0.003	$0.00	--	--	--	--	20.77	--	Stream gravel.
	White Sand Creek	NA	Do..	NA	0.003	$0.00	--	--	--	--	13.50	--	Granitic gravel.

1/ Samples taken by the U.S. Forest Service in 1966.
2/ Samples taken by the USBM during a previous USBM mineral investigation (Storch and Holt, 1963).
3/ A total of 15 placer samples, including those listed above, were taken along Hoodoo Creek during the previous USBM study. The 15 samples ranged between 6.5 and 97.4 kg/m^3 black sand, with between 3.6 and 87.9 kg/m^3 ilmenite, trace and 3.6 kg/m^3 magnetite, trace and 0.59 kg/m^3 garnet, and trace and 1.2 kg/m^3 zircon. They also had trace amounts of monazite (Storch and Holt, 1963, p. 15).

APPENDIX B.--Descriptions and analyses of selected placer concentrate samples from the Elk Summit study area.

[Placer sites shown on figure 2; Au, gold; Ag, silver; As, arsenic; Bi, bismuth; Ce, cerium; Cu, Copper; Hg, mercury; La, lanthanum; Mn, manganese; Mo, molybdenum; Nb, niobium; Pb, lead; Sb, antimony; Ti, titanium; U, uranium; W, tungsten; Y, yttrium; and Zn, zinc; ppb, part per billion; ppm, part per million; < less than; m, meter; --, not analyzed; NA, not applicable; *, sample from bedrock; Do.., same as above.]

(fig. 2 no.)	Name	Sample No.	Type	Length (m)	Description	Au (ppb)	Ag (ppm)	As (ppm)	Bi (ppm)	Ce (ppm)	Cu (ppm)	Hg (ppb)	La (ppm)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Pb (ppm)	Sb (ppm)	Ti (ppm)	U (ppm)	W (ppm)	Y (ppm)	Zn (ppm)
6	Hoodoo placer	3	Auger	1.2	Soil, clay, and granitic grus	<5	<0.2	<5	<5	55	2	<10	22	72	<1	21	<2	<2	10200	--	<10	11	13
		4	Do..	0.1	Coarse granitic grus	<5	<0.2	<5	<5	72	3	<10	28	90	<1	24	2	<2	12500	--	<10	24	14
		5	Do..	0.6	Fine granitic gravel	<5	<0.2	<5	<5	85	3	<10	31	152	1	72	<2	<2	61000	--	<10	20	18
		6*	Do..	0.4	Medium-grained grus and granitic bedrock	<5	<0.2	<5	<5	93	3	<10	35	121	1	37	2	<2	27500	--	<10	19	18
		7*	Do..	0.4	Stream gravel on bedrock	<5	<0.2	<5	<5	--	3	<10	--	108	<1	--	4	<2	19000	--	<10	--	20
2	Kooskooskia Meadow placer	17	Auger	1.2	Soil, clay, and granitic grus	<5	<0.2	<5	<5	--	2	<10	--	45	<1	--	<2	<2	2635	--	<10	--	7
		18	Do..	1.2	Do..	<5	<0.2	<5	<5	--	2	<10	--	57	<1	--	<2	<2	8660	--	<10	--	11
Pan samples from selected creeks in the study area.																							
	Bridge Creek	NA	Pan	NA	Granitic rock flour	<5	<0.2	<5	<5	--	2	<10	--	107	<1	--	2	<2	--	--	<10	--	15
	Colt Creek	NA	Do..	NA	Granitic gravel	<5	<0.2	<5	<5	--	3	<10	--	58	1	--	<2	<2	3125	--	<10	--	14
	Do..	NA	Do..	NA	Stream gravel	<5	<0.2	<5	<5	--	4	<10	--	169	<1	--	3	<2	8650	--	<10	--	25
	Cooperation Creek	NA	Pan	NA	Stream gravel	<5	<0.2	<5	<5	--	6	<10	--	272	1	--	<2	<2	2230	--	<10	--	26
	Rabbit Creek	NA	Do..	NA	Granitic grus	<5	<0.2	<5	<5	--	3	<10	--	108	<1	--	<2	<2	--	--	<10	--	13
	Savage Creek	NA	Do..	NA	Granitic gravel	<5	<0.2	<5	<5	--	5	<10	--	565	2	--	8	<2	4560	--	<10	--	73
	Swamp Creek	NA	Do..	NA	Stream gravel	<5	<0.2	<5	<5	--	17	20	--	360	1	--	7	<2	27500	--	<10	--	58
	Warm Springs Creek	NA	Do..	NA	Do..	<5	<0.2	<5	<5	--	2	<10	--	97	1	--	<2	<2	7650	--	<10	--	16
	Do..	NA	Do..	NA	Do..	<5	<0.2	<5	<5	--	4	10	--	282	1	--	2	<2	10600	--	<10	--	20
	White Sand Creek	NA	Do..	NA	Granitic gravel	<5	<0.2	<5	<5	--	4	<10	--	142	1	--	2	<2	6890	--	<10	--	21

APPENDIX C.--Descriptions and analyses of rock samples from the Elk Summit study area.

[Lode sites shown on figure 2; Au, gold; Ag, silver; As, arsenic; Bi, bismuth; Cu, Copper; Hg, mercury; Mn, manganese; Mo, molybdenum; Pb, lead; Sb, antimony; W, tungsten, and Zn, zinc; NA, not applicable; ppb, part per billion; ppm, part per million; < less than; m, meter; Do.., same as above.]

Map no. (fig. 2)	Name	Sample No.	Sample Type	Sample Length (m)	Description	Au (ppb)	Ag (ppm)	As (ppm)	Bi (ppm)	Cu (ppm)	Hg (ppb)	Mn (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	W (ppm)	Zn (ppm)
1	Jerry Johnson hot springs	51	Chip	6.1	Across breccia above hot springs	<5	<0.2	<5	<5	4	<10	263	2	2	<5	<10	34
		52	Do..	NA	Iron stained granitic rock	<5	<0.2	<5	<5	2	<10	42	<1	<2	<5	<10	6
		53	Do..	0.3	Granitic rock above breccia	<5	<0.2	<5	<5	6	<10	360	2	2	<5	<10	44
5	Savage Pass pit	1	Select	NA	Iron stained calc-silicate rock of Wallace Formation	<5	<0.2	<5	<5	18	<10	170	<1	8	<5	<10	21
		2	Do..	NA	Iron stained granitic rock	<5	<0.2	<5	<5	13	<10	110	1	7	<5	<10	40